Mouse cursor control system using EMG

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Abstract- **The amptee cannot operate a mouse freely when they use personal computer. Also there are few people who think it easy to use computers among the old. Then, we develop the new type man machine interface using an electromyogram (EMG). The advantage of EMG is the following two. The first is that, we can control EMG freely. The second is that, what is necessary is just to put electrodes on the skin surface.**

In this study, the operation of a mouse cursor is reproduced (up, down, left, right, right click, left click). We used EMG for the input and the output of the system is mouse cursor operation. Operation of a mouse cursor was judged by the neural network. The neural network was taken as three inputs, two hidden layers, and the one output layer. We were able to do cursor operation 70% reappearance as a result.

***Key word*- electromyogram, amptee**

I. INTRODUCTION

In recent, it has increased to use a personal computer on business or for pleasure. We usually use pointing devices such as a mouse. However, mouse operation causes a trouble for the amptee and old when they use personal computer.

Now, the amptee is accounted 1.6% of the total population in Japan. And, the old-people population aged 65 or more years old is going to be over 20% by 2020.

They need to appead to society without distinction from healthy person. In order that they might be accepted in the society, they should have the same capability as healthy people or young people. Therefore, tools and instruments that are easy to use for them are needed.

Today they use various pointing devices, such as speech-recognition mouse, head pointer and joy sticks when using personal computers. However, they seem to be hard for them.

Then, we directed our attention to electromyogram (EMG) with two features.

1. We can control EMG freely.
2. What is necessary is just to stick electrodes on the skin surface.

In this study, we are development of the new type mouse cursor control system which used EMG.

II. SYSTEM

We developed the new type man machine interface. The input of the systems is EMG signal. The mouse cursor was operated by the output signal. Operation of a mouse cursor was judged by the neural network.

As the reason we use a neural network is its capability of (adaptability). The signal with much noise can be processed easily (pattern matched).

We chose three muscles on forearm. We put electrodes Ag-AgCl on those muscles. A stainless steel electrode was used for reference electrode. Fig.1 shows the position of the electrodes.

We wiped off the skin by alcohol, before putting electrodes. Therefore, we decreased the contact impedance between the skin and electrodes.EMG signals from those muscles were converted to the movement of mouse cursor (up, down, left, right, right click, left click).

Actually we use the integrated electromyogram (IEMG) not raw EMG. The reason is that IEMG can be an estimate of muscle force.To get IEMG, we processed the EMG signal as follows. At first, the EMG signal is amplified to enough voltage for the processing, because its amplitude is from a few V to 10 mV. After amplification, the signal is fed to the full wave rectification circuit. And then the output signal is fed to the low-pass filter whose cut off frequency is 2.6Hz. Above mentioned process is shown in Fig.2.

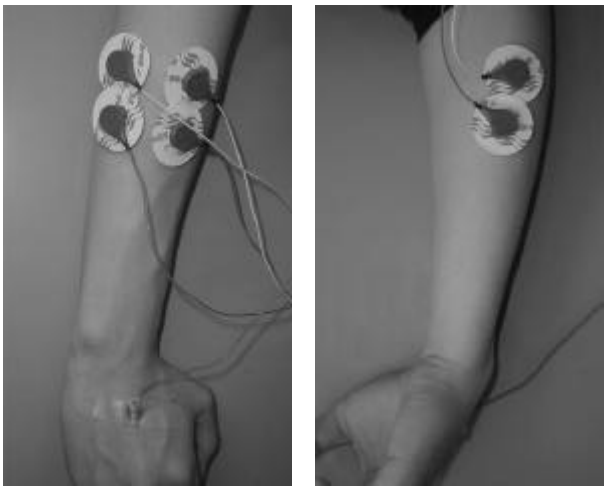

Fig.1 position of the electrodes

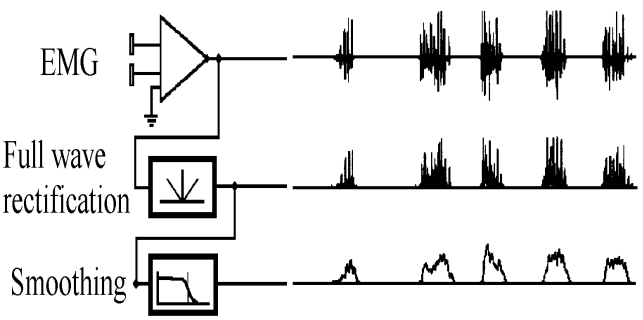

Fig.2 rectifying and smoothing EMG

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Abstract

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We inputted IEMG signal into the personal computer with A / D conversion card made by National Instrruments (DAQCard-1200), whose sampling frequency is 64Hz. In this time, we used the software(LabVIEW6i) for measurement .

We processed IEMG signal by the neural network which manufactured by MATLAB6 (MATHWORKS).

We used Back Propagation algorithm for a neural network's study method. We perform the pattern recognition of operation set up beforehand. 1000 times of study are performed. Fig.3 show system configuration.

Then, it was checked whether operation would be outputted according to operation of a subject. In this study, our mouse operation is up, down, left, right, right click, left click.

We measured each 50 trials for each subject and took out the rate of recognition.

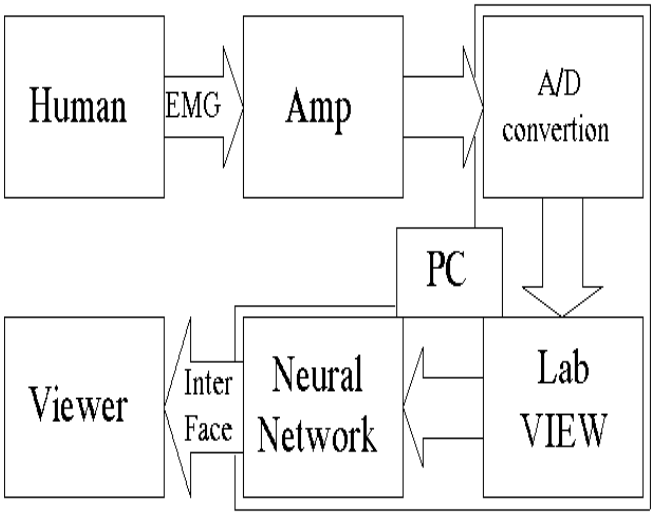

Fig.3 System configuration

III. RESULTS

TABLE.1 shows the average with 50 trials for all subjects. The subjects are seven health males and females. NON shows the state where cursor is not moved. The rate of recognition of each operation exceeds 70%.

Moreover, the rate of recognition, difference appeared by the individual. Next, we show seven men top result and the worst result that were measured. TABLE.2 shows best result. TABLE.3 shows worst result.

The factor that brought such result; EMG signal was small.

TABLE.I Average result

	UP	DOWN	LEFT	RIGHT	CLICK L	CLICK R
NON	9.75	12.25	8.75	9.75	8.75	6.75
UP	55.50	2.25	4.25	2.00	4.75	1.25
DOWN	0.00	65.75	1.25	0.50	0.50	1.00
LEFT	4.00	5.00	65.00	5.25	2.38	6.00
RIGHT	11.75	0.75	6.25	55.75	0.75	2.00
CLICK L	9.75	10.75	13.00	21.25	80.88	9.25
CLICK R	9.25	3.25	1.50	5.75	2.00	74.38

TABLE.II Best result

	UP	DOWN	LEFT	RIGHT	CLICK L	CLICK R
NON	12	26	6	24	18	0
UP	78	8	28	0	0	0
DOWN	0	66	0	0	0	0
LEFT	0	0	58	0	12	0
RIGHT	0	0	4	76	0	0
CLICK L	10	0	2	0	70	2
CLICK R	0	0	2	0	0	98

TABLE.III Worst result

	UP	DOWN	LEFT	RIGHT	CLICK L	CLICK R
NON	4	22	14	10	38	18
UP	22	0	0	0	0	0
DOWN	0	42	0	0	0	0
LEFT	24	20	38	12	0	46
RIGHT	22	4	0	4	0	0
CLICK L	28	12	48	74	62	8
CLICK R	0	0	0	0	0	28

IV. DISCUSSION

As a result of our experimenting, the rate of recognition in a mouse cursor became low with 70%.

It is considered because the output result of each operation was similar. Moreover, when we used it for a long time (40 minutes - 60 minutes), muscular fatigue appeared. In this time, the rate of recognition fell. However, recovery of muscles fatigue raised the rate of recognition again.

In order that we might make operation intelligible this time, operation of cursor was performed by using the Muscles of an forearm part.

Here, any Muscles can be used for it as long as we use the muscles that can perform optional movement. That is, it also enables us to operate a mouse cursor using a leg.

V. CONCLUSION

We raise the Percent of recognition. We need to raise the ease of using. Until now, the directions should be extended from 4 to 8. And drug operation etc. is needed.

In this study, we discovered that the healthy person. We should add old people and amptee as participate in our measurement, and need to examine a measurement result. In that case, we need to consider the processing method of small EMG signal. In this study, our system needs one more personal computer. And, we need to examine a different system.